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Office of Space Science

**STRUCTURE AND EVOLUTION OF THE UNIVERSE
SUBCOMMITTEE**

**OF THE
SPACE SCIENCE ADVISORY COMMITTEE**

July 1–2, 2003

**NASA Headquarters
Washington, D.C.**

MEETING REPORT

Paul Hertz
Executive Secretary

Edward W. Kolb
Chair

STRUCTURE AND EVOLUTION OF THE UNIVERSE SUBCOMMITTEE (SEUS)

July 1–2, 2003
NASA Headquarters
Washington, D.C.

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STRUCTURE AND EVOLUTION OF THE UNIVERSE SUBCOMMITTEE (SEUS)

July 1–2, 2003
NASA Headquarters
Washington, D.C.

Tuesday, July 1

Joint Meeting with Origins SubcommitteeWelcome, Introductions, Logistics

Dr. David Spergel, Chair of the Astronomical Search for Origins and Planetary Systems Advisory Subcommittee (OS), opened the meeting. The members of both subcommittees introduced themselves, followed by the NASA attendees and others present. Dr. Paul Hertz, Executive Secretary of SEUS, reviewed the ground rules for open subcommittee meetings, noting that this was an open meeting with members of the public and NASA contractors present.

A&P Update

Dr. Anne Kinney, Director, Astronomy and Physics Division (A&P), provided an update on Division activities since the subcommittees last met in February 2003. The Beyond Einstein initiative is included in the President's Budget Request for Fiscal Year 2004 (FY04), and Dr. Kinney noted the value during the budget discussions of having news of SEU science results being reported by members of the science community. One of the Mars Exploration Rovers (MER) has been launched; the second is still under a launch delay. Among the resource challenges facing the division is the cost of the delay in maintenance of the Hubble Space Telescope (HST) due to the loss of *Columbia* and the subsequent Shuttle stand-down. The HST delay cost is \$8–\$10 million per month, and the period for March through September 2003 will be covered by taking funds from the James Webb Space Telescope (JWST) program. A new HST panel has been formed to summarize the options for a propulsion module that will allow controlled de-orbiting of HST when its operational life is ended. Several OS members had questions about the end-of-mission planning for HST. Another panel is studying the transition from HST to JWST, with the objective of providing flexibility in continuing to operate it beyond 2010, if it remains functional. A second A&P challenge, the launch of the Space Infrared Telescope Facility (SIRTF), has been delayed until August. The third major challenge has been the delays and cost increases in the Gravity Probe-B (GP-B) program since the spacecraft failed its thermal vacuum test in December 2002. Two reviews, including science and technical/risk reviews by separate panels, were conducted over the past period, and termination of the program was seriously considered. The decision by Dr. Edward Weiler, Associate Administrator for Space Science, was to give conditional approval for GP-B to proceed toward launch, which is now scheduled for November 2003. The GP-B spacecraft recently completed another thermal vacuum test and appears to have passed. Dr. Kinney has given Dr. Weiler a plan to cover the added costs of HST and GP-B. The additional funding needed for both missions will come in the near term from the JWST program, which is in the Origins theme. The gap in JWST funding for FY06-07 will be covered by taking funds from the Beyond Einstein budget in the Structure and Evolution of the Universe (SEU) theme.

Science highlights from operating missions include observations of seasonal weather changes on Neptune by the HST and detection of a gamma-ray burst, which has been linked to a supernova, by the High Energy Transient Explorer (HETE). The Chandra spacecraft has detected activity in Stephan's Quintet and evidence of super black-hole development in early galaxies. Galaxy Evolution Explorer (GALEX) science observations are beginning. (Initial GALEX observations were described informally to the subcommittees during the lunch break.) Dr. Kinney reviewed the NASA Space Science Updates that have focused on SEU and Origins topics this fiscal year and the 8 space science launches achieved or planned from January 2003 through January 2004.

The operating missions are all green on the status chart. Of the developmental missions, GP-B has moved from red to yellow after the approval to continue. The Swift Gamma Ray Burst Explorer (Swift) has been rescheduled for launch in January 2004. The Spectroscopy and Photometry of Intergalactic Medium (IGM) Diffuse Radiation (SPIDR) mission was terminated in April. (On Wednesday morning, Dr. Hertz described the circumstances leading to the SPIDR termination; see below.) Dr. Kinney and the members discussed

how instrument development projects for missions led by the European Space Agency (ESA) are being affected by budget problems among the ESA member states. One consequence is that ESA is taking on management of the contributions from the 11 member nations, an approach that Dr. Kinney believes will be desirable for use on the Laser Interferometer Space Antenna (LISA) mission. Dr. Ulvestad suggested that A&P check with the National Science Foundation (NSF), to see how this ESA approach worked on the Atacama Large Millimeter Array (ALMA). Dr. Kinney reviewed the NASA Space Science budget history, the budget breakout for the five Space Science themes in the President's Budget Request for FY04, and the allocations to individual space science missions in FY03 and FY06 (planned). She finished the presentation with an overview of planning for the Beyond Einstein initiative. During the question session, SEUS and OS members discussed with Dr. Kinney NASA's role in future ESA-led missions and the impact of European budget problems on joint projects such as the Gamma-ray Large Area Space Telescope (GLAST).

Report from the Science Archive Working Group (SAWG)

Dr. Joel Bregman, a member of the SEUS and Chair of the SAWG, reported on the April 22–23, 2003, meeting of the SAWG. The main issues were the Celestial Navigator System (CNS), the Legacy Archive for Microwave Background Data (LAMBDA), and the Applied Information Systems Research Program (AISRP). With respect to the proposed CNS, the SAWG has made a request to the Astrophysics Data Centers Executive Committee (ADEC) to develop interoperability capabilities between NASA astrophysics data centers, as a precursor to a National Virtual Observatory, which would support the primary goals of the SEU and Origins roadmaps. Although the individual data archive programs have been working toward interoperability, funding has been lacking to achieve the objectives. The Interoperability Initiative would improve connectivity among the NASA archive centers and provide a uniform set of improved services. The SAWG thought the LAMBDA archive has a well designed website with easy data access. The one concern was with the HEALPix format used for cosmic microwave background (CMB) data sets. This format requires special software routines from the web site of the Conseil Européen pour la Recherche Nucléaire (CERN). The AISRP has had some successes with software, including virtual observatory tools that have been widely adopted in the archival community. However, it lacks the resources needed for the CNS initiative. The SAWG recommended that AISRP needs a better-established venue for disseminating its products, such as a journal. The questions from SEUS and OS members focused on the integration of the NASA and NSF archives. The CNS initiative would be synergistic with the NSF program and would apply the same standards. The CNS master database would cover both ground-based (NSF facilities) and space-based (NASA spacecraft) data sources. The proposal for a 3-year CNS development program would exceed the current AISRP budget. The members discussed whether research and analysis (R&A) funding in Space Science was adequate to make the Interoperability Initiative of optimal value to the science community. Dr. Kinney noted that collaboration with the California Association for Research in Astronomy (CARA) on the Keck Interferometer is going well.

Report from the Astronomy and Physics Working Group (APWG)

Dr. Kathryn Flanagan reported on the June 16–17, 2003, meeting of the APWG. The adequacy of the R&A budget was the issue of highest concern, particularly because R&A as a fraction of the Code S budget is declining. The APWG draft report reviews the reasons why R&A is of value to A&P and to NASA's mission. It proposes several approaches for increasing R&A resources. One of these approaches, the inclusion of R&A-related resources within new initiatives, was discussed at length by the OS and SEUS members and guests. Other topics discussed were the areas of theory that would be fundable by this approach and ways in which new areas of fundamental research can affect competition for resources among programs. Dr. Kinney and Dr. Hertz described the budget and programmatic factors that have affected R&A budget history. Full-cost accounting could further decrease the effective R&A budget. The APWG believes the Research Opportunities in Space Science (ROSS) web site, which is the primary information source for most proposers responding to OSS NASA research announcements (NRA's), should be simpler and easier to navigate. The two subcommittees discussed ways in which the value of R&A could be communicated, both within NASA and to external decision makers.

The APWG draft report includes concerns about the impact on the budget for balloon campaigns of the costs for constructing and upgrading the infrastructure for long-duration ballooning over Antarctica. On a positive note, the report commends the evolving responsiveness of Code R to the fundamental technology needs of Code S. Improvements include Code R NRAs that address specific Code S technology needs and

the increasing fraction of Code R funding that is competed openly and selected with peer-review input. The APWG remains concerned about whether there is a coherent approach for developing new technology through the Technology Readiness Levels (TRLs) necessary to support future major science missions.

Report from the National Astronomy and Astrophysics Advisory Committee (NAAAC)

Dr. Robert Gehr, NAAAC Chair, briefed the SEUS and OS by telephone on the April 8-9, 2003, meeting of the NAAAC. Interim recommendations from the NAAAC have been submitted to the Office of Management and Budget (OMB). Dr. Gehr reviewed the NAAAC charter, which was incorporated in legislation authorizing the NSF. The charter directs NAAAC to conduct assessments and make recommendations on (1) gaps and duplication between NSF and NASA in R&A programs, missions, observatories, archives, etc.; (2) coordinating the strategic plans for astronomy and astrophysics of the two agencies, and (3) advising on specific areas that may benefit from interagency coordination. The NAAAC can also conduct specialized studies, as requested by NSF and NASA. Dr. Gehr listed seven members who are already approved and noted that additional members were in the process of being nominated and approved. With respect to coordination between NAAAC and the Committee on Astronomy and Astrophysics (CAA) of the National Research Council (NRC), the CAA focuses on refining and promoting the strategy for the long-range plan for astronomy. The NAAAC identifies tactical approaches to pursuing the long-range plan when inter-agency coordination is involved.

The April 23, 2003, NAAAC report identifies four major ventures (science objectives) for which the NAAAC recommends an integrated (interagency) management approach. For each venture, the report cites a NASA-led project and a NSF-led project that should be coordinated. For the first science venture—understanding the formation and chemical evolution of galaxies within a billion years of the Big Bang, and [understanding] the formation of stars and planets—the two cited projects are the JWST and NSF's Giant Segmented Mirror Telescope (GSMT). For determining the nature of the dark energy and dark matter in the universe, the cited projects are NSF's Large-aperture Synoptic Survey Telescope (LSST) and a complementary orbiting observatory. The report describes ways in which NASA could collaborate on LSST. The third theme—probing the temporal and structural development of solar magnetic fields and activity through contemporaneous observations—cites NASA's Solar Dynamics Observatory (SDO) and NSF's Advanced Technology Solar Telescope (ATST), although the report notes that contemporaneous observations will require accelerating the ATST program. For investigations of the CMB to detect the signature of inflation (following the Big Bang), the cited projects are NASA's Wilkinson Microwave Anisotropy Probe (WMAP), ground-based microwave telescopes at several sites, and payloads in the Long-Duration Balloon (LDB) program. To provide the technical infrastructure necessary for these four major ventures, the NAAAC report cites the National Virtual Observatory (NVO), as well as support for instrument development, computing, laboratory measurements, and R&A. It notes that archiving systems for data from ground-based sources lags far behind such systems for space-based sources. In discussing challenges to NASA–NSF collaboration, the report recommends that the agencies find opportunities where relaxation of the traditional separation between ground-based and space-based astronomy will benefit broader scientific goals.

Joint Discussion

The OS and SEUS discussed the asymmetry between NASA and NSF with respect to the extent of advisory committee involvement. Dr. Kinney said that four advisory committees or their subcommittees and working groups already advise A&P: SEUS, OS, APWG, and SAWG. Another topic of discussion was the size of the NSF budget for university grants in astronomy and astrophysics relative to the NASA A&P budget for R&A and the doubling in recent years of the overall NSF budget. The potential for the NAAAC to represent the relevant science communities to the top levels of NSF and NASA, as well as to OMB, was also discussed. Dr. Spergel suggested that the search for planets was another potential science venture for which collaboration between the agencies should be considered by the NAAAC. Several OS and SEUS members raised concerns with whether the recommendation to relax the traditional separation between NSF and NASA projects would lead to a one-way drain on NASA resources to support ground astronomy facilities, without an equivalent response from NSF in support of NASA space missions. The relation of LSST to Origins and SEU objectives was discussed, as well as its principal relevance to the OSS Solar System Exploration theme. Dr. Gehr agreed with Dr. Lee (Sam) Finn's formulation that the two agencies should agree on joint science goals, then develop appropriate missions/projects for each agency to pursue

those goals, rather than simply fitting existing missions under a common theme. Dr. Gehrz, Dr. Kinney, and others discussed the approaches of the two agencies to long-term planning. Several SEUS/OS members urged representation on the NAAAC of astronomy disciplines other than optical and near-infrared astronomy.

SEUS Separate Session

The joint session adjourned, and the SEUS reconvened by itself in Room 9H40. This separate SEUS session was also an open meeting. The SEUS meeting was chaired by Dr. Edward (Rocky) Kolb.

SEU Update including Beyond Einstein

Dr. Paul Hertz, as SEU Theme Scientist, expanded on the SEU portions of Dr. Kinney's A&P update. All SEU operating missions have a stoplight status indicator of green. With respect to missions still in development, the status of Swift is yellow because of ongoing work on the telescope, integration and test of the wiring harness, and a shift of scheduled launch from December 2003 to January 15, 2004. For Astro-E2, a mission led by Japan's Institute of Space and Astronautical Science, NASA is providing an x-ray spectrometer and telescope mirrors. Schedule time was lost because of a Dewar leak on the x-ray spectrometer and a shake test problem with one mirror. Astro-E2 launch is now scheduled for February 2005. Dr. Hertz noted the status of GP-B (replan approved with launch scheduled for November 2003) and SPIDR (terminated); details of each were presented during the separate SEUS session on Wednesday. The program status for GLAST is yellow because of the withdrawal of the French space agency, Centre National d'Etudes Spatiales (CNES), from support for the large telescope calorimeter. This support will be provided now by NASA and the Department of Energy (DOE), but schedule time will be lost and project costs will exceed plan. The dollar cost of the CNES withdrawal on GLAST is about \$5 million for the work to be picked up and \$5 million for the schedule slip. The NASA portions of the Herschel and Planck missions are green, but these ESA-led missions are facing problems in instrument development by European countries with budget problems. SEUS members discussed changes in mission funding approach and integration/test processes being considered by ESA to decrease the program risks in the current mission planning approach. The Extreme Universe Space Observatory (EUSO) is a large Fresnel telescope to detect cosmic rays beyond the GZK cutoff. It will fly on the International Space Station (ISS), and NASA recently selected a proposal to supply the optics for EUSO as a NASA Explorer mission of opportunity, as part of the recent Medium-class Explorer (MIDEX) competition. ESA is still in the decision process on whether to proceed with EUSO.

Dr. Hertz reviewed the press events in the past year stemming from SEU missions. He emphasized the difference between the science selection process and the identification of newsworthy science results from missions, after their selection, development, and implementation, for public affairs press releases and press events. To get media attention, the NASA release has to be simultaneous with or prior to publication or announcement elsewhere, including notices in *astro-ph*.¹ For news releases to be effective, there must therefore be prior planning, so that the NASA announcement is not preceded by announcement in another venue. With respect to timing, these public affairs events differ in timing constraints from education and public outreach (E/PO) uses of science results.

The management reviews of the technology readiness and implementation plans (TRIPs) for the LISA and Constellation X (Con-X) missions have been completed. Developmental budgets for both missions are in the President's Budget Request for FY04. A Beyond Einstein Program Office (BEPO) will be established at Goddard Space Flight Center (GSFC) this summer to manage both LISA and Con-X, beginning with Phase A. The LISA TRIP covered the entire project, which is a NASA–ESA collaboration, not just the NASA portions. The ESA's second Small Mission for Advanced Research in Technology (SMART-2) will be used as a demonstration flight for LISA technology, with side-by-side testing of two gravity measurement packages. The formulation review panel for the LISA TRIP concluded that the SMART-2 flight is critical for proceeding to LISA implementation. Although the implementation panel's evaluation of the LISA TRIP noted concerns about the short time for SMART-2 results to influence the LISA design and the modest schedule reserves in some areas, the panel cited the integrated modeling approach, systems

¹ The online eprint journal for astrophysics preprints, *astro-ph*, is available on the Internet at:
<http://arxiv.org/list/astro-ph/info>.

engineering, and overall strength of the LISA team as positive factors. The conclusions from the three TRIP review panel for Con-X were also presented and discussed. In response to a question, Dr. Hertz said that the decision to schedule LISA as the first Beyond Einstein mission was made before the TRIP evaluation reports were received.

Mission concept proposals have been received for the Einstein Probes. Proposals were received for all of the concept options in the announcement. Although the Dark Energy probe will be a NASA-only mission, DOE's Division of High Energy Physics will be an informal partner, as preparation for a joint NASA–DOE mission on dark energy. The President's Budget Request for FY04 does not include funding for Einstein Probes before FY07. Both NASA and DOE want to begin work on Einstein Probes before FY07. The SEUS and Dr. Hertz discussed issues in partnering with DOE on a dark energy mission, including differences in management culture and in selection and funding practices.

OSS has released a Vision Missions NRA covering 17 vision missions drawn from the five OSS theme roadmaps. Proposals are due September 12. The goals are to acquire a better understanding of far-term missions and formulate requirements for NASA-wide planning. About 12 proposals for all five themes will be selected to conduct 12-month studies.

Beyond Einstein E/PO Plans

Dr. Hertz described the E/PO Plans for the Beyond Einstein Initiative in the context of the ongoing start-up of a new Agency-wide Office of Education (Code N). E/PO activities throughout NASA, including OSS E/PO activities, are being coordinated with Code N. The Space Science Advisory Committee (SScAC) Education and Public Outreach Task Force reported at the March 2003 SScAC meeting on OSS progress in E/PO since FY96.² The report, referred to as the Knappenberger Report, was discussed in May by the OSS Education Council, which consists of NASA E/PO managers and staff. The task force recommended that OSS needs a road map to align the Space Science curriculum to national K-12 science education standards. The E/PO products need to be more accessible and should be organized to omit pervasive overlaps. Other recommendations dealt with communication of E/PO products and activities to broaden the audience and improve quality. With respect to the Code N strategic plan, Code S E/PO is viewed as a model. A Space Science Education Framework initiative has been established, with the goal of enabling teachers to use space science materials within a more coherent framework than the current mission-focused materials.

The significance of these broader E/PO activities for Beyond Einstein is that it has the opportunity to be the vanguard effort under the new paradigm. The plan includes a strategy workshop to bring together personnel with mission, SEU Forum, broker/facilitator, and SEU theme perspectives, followed by sessions to develop a transitional E/PO element and an end state element. Interactions with the SEUS will be included, as well as involvement from the SScAC task force, Code N, and the Space Science Education Framework group. A draft Beyond Einstein E/PO strategy document will take about 6 to 8 months to develop and move through the review process. The final product will be presented to Anne Kinney, Paul Hertz, and Jeff Rosendhal.

Among the issues discussed in response to Dr. Hertz's presentation was the need for a change in the role of broker/facilitators. Also discussed were continuity for E/PO strands after missions end and other topics related to a more coordinated E/PO approach (across missions). A final question was how the larger "public outreach" will be handled, if Code N is focusing on K-12 education.

Interagency Coordination

Dr. Hertz introduced the session by referring to an Interagency Working Group of the National Science and Technology Council (NSTC) on the Physics of the Universe. This NSTC group was set up to respond to the NRC's *From Quarks to the Cosmos* report. Dr. Patrick Looney, Assistant Director for Physical Science and Engineering in the Office of Science and Technology Policy (OSTP), then discussed the connections between OSTP physical science policy priorities and the SEU theme. He noted changes in the environment

² Space Science Advisory Committee Education and Public Outreach Task Force. *Implementing the Office of Space Science Education/Public Outreach Strategy: A Critical Evaluation at the Six-Year Mark*. March 21, 2003. Available on the Internet at :

<http://centauri.larc.nasa.gov/newfrontiers/NASA_OSS_EPO_TF_Report_FINAL.pdf>.

for large-scale science program investments and some “rules of engagement,” which agencies are encouraged to consider in their budgets and program planning. This administration is placing greater emphasis on understanding what the nation will get from an R&D investment, minimizing redundancy, and maximizing the return on the existing investment base. Another OSTP concern is coordinating the advice received from the many federal advisory committees and NAS/NRC committees with overlapping recommendations. Dr. Looney reviewed important elements of a recent memo from OSTP and OMB on science-related priorities. With respect to how this environment affects SEU, it is important that the budget rationale for space science missions argue convincingly from the science drivers for each mission, making clear why the mission is important and why it is timely to do it when proposed. The big-ticket priorities for the administration are (in priority order) R&D for homeland and nation security, nanotechnology, networking and information technology R&D, molecular-level understanding of life processes, and environment and energy. SEUS members discussed with Dr. Looney how the NVO initiative could fit under the third priority.

Participants in the Interagency Working Group on the Physics of the Universe represent the NASA Office of Space Science, the NSF Astronomy and Physics divisions, the NSF Office of Polar Programs, three DOE offices, OSTP, and OMB. The group has a set of questions to address in its response to *From Quarks to the Cosmos*. The group’s report, which should be available by the end of July, will reflect elements of the President’s Management Agenda, including relevance, quality, and performance as R&D investment criteria; prioritization; and coordination of investments. Dr. Looney referred to the report, *U.S. Astronomy and Physics: Managing an Integrated Program*, from the NRC’s Committee on Organization and Management of Research in Astronomy and Astrophysics (COMRAA), which led to the formation of NAAAC. Because of NAAAC’s legislative charter, it is an important avenue for interaction with the House Science Committee. When asked if OSTP would provide leadership on issues reflecting differences in agency cultures and strategic plans, Dr. Looney said that the “steward agency” in a given field will be expected to take the lead, not OSTP. SEUS members noted areas of high-energy astronomy that are not yet reflected in the NAAAC membership or the latest NAAAC interim report.

GPRA FY03 Metrics

Dr. Hertz introduced the staff-produced draft for NASA’s self-assessment of performance in achieving metrics for FY03, as required by the Government Performance and Reporting Act (GPRA). The OSS metrics for FY03 include several that are nonquantitative because they reflect the general goal of achieving science objectives. OMB has directed that the NASA Advisory Council (NAC) is responsible for assessing the extent to which these nonquantitative metrics have been met. The NAC has delegated the assessment to the SScAC, which has requested input from its subcommittees.

The SEUS considered each of the five science-related goals relevant to the SEU theme and their ratings on a four-level color scale (red for inadequate progress, yellow for some progress but not enough, green for good progress, blue for progress beyond reasonable expectation). The SEUS reviewed the rationale given for the ratings suggested by SEU staff. In addition to discussing the rating appropriate for each metric, the SEUS added and revised the supporting items, based on science results that occurred in 2003 and their scientific importance.

Discussion

The chair led a discussion of topics from the day’s presentations that should be discussed with Dr. Kinney during the next day’s closing session, in preparation for drafting a SEUS letter to the SScAC. A preliminary set of topics was developed, and individual members were assigned to draft statements of SEUS views, to be discussed further on Wednesday. The meeting was adjourned for the day at 5:45 p.m.

Wednesday, July 2

Joint Session with Origins Subcommittee (OS)

The SEUS and OS met in a second joint session, which started at 8:20 a.m. on Wednesday, July 2.

Future Explorer Program

Dr. Hertz, in his role as Explorer Program Scientist, briefed the OS and SEUS on plans and options for the program. At the August meeting, the SScAC will be discussing the cost caps on the three Explorer project classes, particularly for the Small Explorer (SMEX) class. An option suggested by a member of the Space Science Advisory Committee (SScAC) is to drop SMEX and add a class for missions larger than the MIDEX cap allows. Because the Origins and SEU communities would be affected by this option, Drs. Spergel and Kolb will bring the views of their subcommittees to the SScAC meeting.

Dr. Hertz reviewed the three current Explorer classes, the history of changes in their cost caps, and how the cost caps are set. The costs of the expendable launch vehicles (ELVs) typically used for SMEX and MIDEX missions were discussed. The bottom line with respect to the cost cap history is that accomplishing the same science on a mission has required increasing the cost caps on both classes, as programmatic requirements have increased. The two most recent SMEX projects have had problems staying within their caps without descopeing the mission science. Because the total size of the Explorer program is relatively constant and likely to remain at current levels, increasing a cost cap decreases the flight rate for that class. The Explorer missions now in development include three MIDEX missions (Swift, THEMIS, and WISE), one SMEX mission (AIM) and four missions of opportunity (CINDI, TWINS, Astro-E2, and EUSO). The members asked about the quality of SMEX proposals, particularly the number of category 1 proposals (rated as compelling science). Launch vehicle options were discussed, including use of the Shuttle or launching a SMEX spacecraft as a secondary on the ELV for another mission. Dr. Hertz listed the reasons for a programmatic adjustment in the SMEX cap as part of the 2003 Announcement of Opportunity (AO). He concluded with the three Explorer program options that the SScAC will be considering: (1) one MIDEX and two SMEX missions every three years; (2) one MIDEX and one large-class mission every three years; or (3) one SMEX, one MIDEX, and one large-class mission every 3.5 years.

Discussion

This session continued discussing options for the Explorer program. The Origins and SEU communities typically win about half of the Explorer missions through the competitive proposal and selection process. One SEUS member noted that the revised cap for the 2003 SMEX AO had made it easier to develop a strong proposal than could be done under the previous cap of \$75 million. Reserve requirements and the cost assessment process during proposal review were discussed. Dr. William Oegerle of OS and other members suggested the option of having no fixed allocation among the Explorer classes. Reasons for and against this option were discussed. Another issue was the impact on focus missions, such as the Einstein Probes, of introducing a large-class Explorer. Trade-offs between having more frequent but smaller missions versus less frequent larger missions were discussed, particularly with respect to effects on new scientists entering the field. Members of each subcommittee voted on the three program options. The OS and SEUS chairs will report the results of the vote, along with the range of views expressed by their members, to the SScAC.

Code R Technology NRAs

Dr. Chris Moore from the Office of Aerospace Technology (Code R) spoke to the OS and SEUS about fundamental technology development for space science. He began with an overview of how the four strategic themes of the Aerospace Technology Enterprise contribute to technology development and transfer for the other NASA enterprises, the aerospace industry, non-aerospace industry, and educators. The Mission and Science Measurement Technology (MSM) theme, which has the most direct links to OSS technology needs, comprises three major programs: Engineering for Complex Systems; Enabling Concepts and Technologies (ECT); and Computing, Information, and Communications Technology. The new strategy for technology development uses input from a newly formed Technology Executive Board, plus technology assessments, to define crosscutting technology needs. These needs are addressed through externally competed NRAs or in-house exploratory research. Once proof-of-concept integrated systems are achieved, the technology will enter a transition from Code R exploration to further development via the AOs and focused technology programs of other NASA enterprises. The exploration phase within Code R will aim at achieving TRL 3 or 4, with the transition phase achieving TRL 5 to 6. In response to a question, Dr. Moore described this strategy of getting all the way to TRL 6 during the transition phase as a new approach in Code R to bridge the technology development gap from TRL 4 to 6. He listed the technology

needs and priorities identified by the new Technology Executive Board, highlighting the priorities identified for OSS.

Dr. Moore then described the current projects within the ECT Program, which he heads, with emphasis on the Advanced Measurement and Detection project and its relevance to Code S missions. Recent and ongoing technology tasks include cryogenic cooler technology, direct detectors and focal planes, superconducting components for terahertz receivers and detector arrays, and technology for the dual anamorphic reflecting telescope (DART). Among the technology assessments being conducted by the ECT Program is one for Code S, which will identify and prioritize high-payoff technologies for large telescope systems. A panel of 25 astronomers was convened to define the scientific measurement capabilities needed in the infrared and far-infrared range. A \$39 million NRA for MSM, to be issued on August 4, 2003, reflects A&P technology priorities.

During the question period, Dr. Kinney noted that the forthcoming Code R NRA represents a great success in pursuing Code S technology needs. She and members of the SEUS and OS voiced approval for the directions indicated by the MSM NRA and the overall strategy that Code R is implementing. Dr. Moore anticipates there will be two or three NRAs per year that reflect technology priorities of the other NASA enterprises. There is not yet a unified Office of Aerospace Technology web site, with accessible information on the technologies on the shelf or being developed. Dr. Douglas Richstone of the OS said that the APWG still has questions about the process by which Code S informs Code R of its technology priorities. In response to a question from Dr. Spergel, Dr. Hertz said that technology most often moves from the Code R level to availability for competed missions (Explorers, etc.) through leveraging from focus missions and other programs.

SEUS Separate Session

The joint session adjourned at 12:10 p.m. The SEUS members attended a NASA Space Science Update at 1:00 p.m., then reconvened their meeting in Room 9H40. This separate SEUS session was an open meeting.

GP-B Programmatic Update

Dr. Michael Salamon, NASA program scientist for GP-B, briefed the SEUS on the recent reviews of the project and its current status. He began with a summary of the past history of problems on the project, leading up to the problems encountered during thermal vacuum testing in December 2002. Replans for GP-B began in November 1999, with the fifth replan in 39 months being proposed in January 2002. There have been 37 months of cumulative delay from the original schedule. The project budget has increased by about \$166 million, from \$353 million in 1994 to \$519 million after the fifth replan. At the February 26, 2003, OSS Enterprise Program Management Council (EPMC), the proposed fifth replan was not approved, but the project was allowed to proceed to a launch date no later than November 20, 2003. Two independent panels were set up to evaluate the science and the technical/risk aspects of the project. The charge to the science panel asked if there has been erosion in the scientific importance of GP-B's primary science goals over the last decade. It also asked the science panel to place the science potential of GP-B in the context of SEU missions of comparable cost. Dr. Salamon reviewed the work done by the GP-B science team (led by Stanford University) to establish the science base for the probe and improve the precession error rate, on which the sensitivity of its measurements depends. He also reviewed the progress since GP-B was proposed in ascertaining the two key parameters (geodetic precession and frame dragging) by other experiments. Key passages from the science panel's response to the two parts of the charge were presented and discussed, along with the overall supportive stance of the science panel toward continuing with GP-B. The technical/risk panel reported a low confidence that GP-B would meet the launch readiness date of November 2003. However, the technical/risk panel expressed high confidence that the mission would succeed after launch, provided that it could meet five specific technical requirements.

At the April 30, 2003, OSS EPMC meeting, the two evaluation panels reported their findings. The Marshall Space Flight Center (MSFC) Project Manager for GP-B responded to the technical/risk findings; the Principal Investigator from Stanford University responded to the science panel findings. Although A&P recommended canceling the mission, the EPMC decided to continue the project, provided that it pass two technical gates and adhere to the schedule for a November 2003 launch. One of the technical gates—a successful thermal vacuum test—has now been completed, and the project team appears to be progressing

reasonably on the second gate: successful Ops Preparation. In response to questions from SEUS members, Dr. Hertz reviewed the plan by which the additional funding for GP-B will be taken in the near term from the JWST project, to be repaid in FY06-07 from the Beyond Einstein initiative.

SPIDR Programmatic Update

Dr. Hertz briefed the SEUS on the cancellation of the SPIDR mission. He reviewed the process by which this project was selected as a SMEX mission. Concerns over details of the data analysis technique were raised during the down-select evaluation in June 2002. An independent assessment panel was convened in October 2002 and delivered its report in February 2003. The validity of the SPIDR technique was confirmed, but an error was found in the calculation of sensitivity (signal-to-noise ratio). Simulation results were consistent with the expectations of the assessment panel. A headquarters review on April 22 led to a recommendation to terminate. The review panel found that the appropriate way to determine the best opportunity for addressing the science objectives generally related to the original SPIDR objectives is through a recompetition by all interested parties. Dr. Weiler made the final decision, and the termination letter was sent to Boston University and GSFC on May 20.

The SEUS discussed what lessons should be learned from the problems with SPIDR and whether the evaluation process should be altered. The general view was that an initial science peer review of proposals would be unlikely to catch an error of the type that occurred in the SPIDR proposal. The independent assessment team had to go to a deeper level of review, requiring several person-months of effort, than a proposal review at the first level could do. Some members suggested that the down-select evaluation team should include enough scientific expertise to evaluate the science *feasibility*, but not a reconsideration of the scientific *merit*, of the competing mission concepts.

GLAST Mission Update

Dr. Jonathan Ormes, GLAST Project Scientist, updated the SEUS on GLAST progress. Spectrum Astro has been selected as the spacecraft contractor. An issue that has arisen is whether the Italian space agency will still provide the Malindi site for downloading data and uplinking spacecraft commands. The key parameters for system engineering all still have margins that are acceptable for this stage of development. The Large Area Telescope (LAT) will meet or exceed the requirements in the GLAST Science Requirements Document. The GLAST Burst Monitor (GBM) will complement the LAT by providing (1) low-energy context measurements with high time resolution and (2) rapid triggers for timing and locating gamma-ray bursts over a wider field of view than LAT provides. Recent progress includes critical design reviews (CDRs) for LAT subsystems and the entire LAT, plus preliminary design reviews for the spacecraft and the flight software. Formal analysis is underway at Johnson Space Center on whether GLAST will require a capability for controlled re-entry.

In April, CNES formally withdrew from funding the LAT calorimeter. Dr. Ormes detailed the plan to make up for the withdrawal with additional support from NASA and DOE. Dr. Hertz noted that the remaining partners are working together well as a team to deal with the CNES withdrawal. The team is also looking for back-up alternatives to the Malindi station for data recovery. Dr. Ormes described the considerations behind the GLAST team's request for relief from the pointing knowledge requirement. There have also been difficulties in producing the application-specific integrated circuit (ASIC) chips for several components. To ensure that the instruments will be well calibrated, he is asking the GLAST science working group to assemble a panel of outside experts to review the calibration plan. Because of the overall complexity of the integration, there will be complete subsystem testing before integration. The schedule is very challenging, and an addition of five months to the schedule margin has been recommended. Dr. Ormes summarized how the potential descope options, if the project were to encounter problems, would affect GLAST science objectives. Any descope options that would help cost and schedule substantially would be "painful" for the science objectives. Among the upcoming events for the project are close-outs on the mechanical/thermal issues from the LAT CDR and completion of subsystem and system CDRs for GBM. Instrument deliveries are currently scheduled for summer/fall of 2005, with launch in September 2006. (This date does not include the five months of additional schedule margin.). In summary, Dr. Ormes said that the project is in good shape. The number and types of problems that have been encountered are typical for a project of this complexity, and the team is working well at addressing them.

Discussion

Dr. Kolb led a discussion of the meeting's issues that should be addressed in the SEUS letter to the SScAC and discussed with Dr. Kinney. The votes on the Explorer program options indicated that most SEUS members favored the existing mix of classes, with a minority favoring the addition of a larger-class Explorer opportunity. SEUS members repeated their interest in further information about the quality of proposals submitted for the 2003 SMEX AO. Reasons for and against other program options were discussed. SEUS members were assigned to lead the discussion with Dr. Kinney and draft language for the SScAC letter, reflecting the SEUS discussions on the Explorer program, the Code R responsiveness to A&P technology needs, GP-B status, and lessons learned from the SPIDR review and cancellation procedure. The SEUS agreed with Dr. Hertz's suggestion that the science peer reviewers during the initial selection process could be encouraged to include any concerns they had on feasibility of the science as comments on their evaluation forms.

After a break for lunch, the SEUS discussed windows for the next meeting, with November 13-14 at GSFC set as the tentative dates, pending coordination of joint sessions with OS³. Individual members then raised issues for discussion. Accelerating the time frame for the Einstein Probes was discussed. Several members expressed interest in including near the beginning of each meeting a brief review of "old business" from the previous meeting, to learn the outcomes of activities on which SEUS provided input. To provide an update on issues from the February meeting, Dr. Hertz described the NASA action on the RadioAstron project, the status of the LDB Program, and the status of the OSS Strategy review. No significant changes have been made to the SEU text in the draft OSS Strategy since the changes recommended by the SEUS were incorporated. The members agreed that the SEUS should be included in the next briefing to OS on the JWST, but the SEUS will not comment formally on the program. Further information was requested on the Supernova/Acceleration Probe (SNAP), a joint project with DOE, particularly in relation to options for the proposed Dark Energy Probe in the Einstein Probe series.

Presentation of Issues to the A&P Director

Mr. Richard Howard, A&P Associate Director, sat in for Dr. Kinney, who had been called to a special meeting on national security. Dr. Kinney joined the SEUS about halfway through the discussion. Dr. Craig Hogan, who led the discussion on GP-B, said that the SEUS thinks the review panels made cogent comments and the A&P Director made the correct decision in her recommendation. The SEUS members regret that the EPMC decision means that the Beyond Einstein initiative will, in later years, be reduced to make up the replan budget for GP-B. However, the members endorse the general management principle, applied in this case, of dealing with project cost problems within the theme involved.

Dr. Harold Yorke led the discussion on Space Science Updates. He said that the SEUS supports use of Space Science Updates to communicate important and newsworthy events to the general public. The updates are generally done well. The one attended by SEUS members on July 2, for example, was well formulated with respect to the background and science import of the event it announced. He added that it is important to avoid any impression that NASA missions are selected for their ability to generate media attention. Mr. Howard and the SEUS members discussed the way in which stories are proposed, vetted, and approved for news attention. Dr. York said that the increased frequency of SEU themes in the Space Science Updates has been noted by the SEUS and is appreciated. The issue of potentially overselling the science was discussed, as were ways of getting notice to the OSS E/PO staff, prior to publication elsewhere, of science results that would make good Space Science Updates.

Dr. Joel Bregman led the discussion on R&A resources. SEUS members would like to see an increase in this area but understands the difficulties that A&P faces in proposing R&A and protecting it from budget changes. Mr. Howard and SEUS members discussed various options for providing resources for the activities that have traditionally come under the R&A heading but might be incorporated within specific projects and programs.

³ Subsequent to the SEUS meeting, the dates of the next SEUS meeting were set to be October 23-24, 2003, at NASA's Goddard Space Flight Center. The OS will be meeting at the same time and place.

Dr. James Ulvestad expressed the SEUS members' concerns with the NAAAC current membership, which needs to be representative of other fields of astronomy beyond the optical and near-infrared observing regions. Other observing regions with potential for interagency cooperation were not reflected in the first interim report and the NAAAC recommendations. The goal of relaxing the traditional programmatic boundaries between NASA and NSF should not become a one-way drain on NASA's budget. SEUS members support the conservative, cautious approach that the A&P Director has taken to greater involvement in ground-based astronomy projects. The initial report does not lead from the science and technology opportunities and challenges as the starting point for developing collaborations. Rather, existing programs with some similarity in approach or goal are lumped together under a thematic heading.

The SEUS members found it useful to hear OSTP's views on pressing for greater interagency cooperation. Dr. Lee Mundy noted that NASA does not have a direct link into the five top administration priorities, as listed in the OSTP/OMB memorandum described by Dr. Looney. The members discussed with Mr. Howard whether and to what extent NASA should seek opportunities for greater involvement in these priority areas.

With respect to the OSS and Code N plans for space science E/PO, the SEUS members appreciate the opportunities the new initiatives offer to find ways of improving and extending E/PO as a major contribution toward achieving NASA's vision. On the options for changes to the Explorer classes, SEUS members generally are interested in more information on the quality of proposals received in response to the 2003 SMEX AO. The general, but not unanimous, feeling was that it might be better to leave the allocation among classes unchanged, at least until the results from the SMEX AO can be evaluated.

Dr. Charles Dermer commented on the presentation from Dr. Moore about Code R's increased responsiveness to OSS technology needs. Positive elements are that Code R appears to be working on bridging the TRL 4-6 gap in technology development and is trying harder to serve the needs of the other NASA enterprises, including OSS. In general, SEUS members were pleased with Dr. Moore's positioning of the Mission and Science Measurement Technology Program, although members would like to know more about the process by which candidates for technology development are proposed and selected. SEUS members are also interested in ways that the Computing, Information and Communications Technology Program in Code R might support OSS technology needs. An issue of interest to the SEUS is whether Code R involvement might help in picking up OSS technology development for continuation beyond TRL 3.

Dr. Michael Cherry expressed the views of many SEUS members who thought A&P handled the SPIDR situation well by obtaining an independent science review and making the decision to terminate. The members discussed with Mr. Howard and Dr. Kinney the difficulties in uncovering science feasibility issues and/or errors during the initial peer review. The option was discussed of including additional scientific reviewers in the Phase A review, but for the purpose of assessing science feasibility rather than science merit.

Dr. Bregman and other SEUS members expressed concerns that NASA not be pushed prematurely into an approach on dark energy probes. Important issues, such as systematics, require attention that another agency may not take as seriously as A&P does. Full and open competition will be essential for finding and encouraging the best science for this important investigation, and a collaboration with DOE should not simply assume that the SNAP approach is the best science. The SEUS will be interested in following the process of advanced concept development for alternative approaches, as the process evolves. Dr. Kolb suggested that a modest tri-agency program to define goals and alternatives could be a good starting point. The Beyond Einstein roadmap would provide NASA with a starting position.

In closing, Dr. Kinney urged the SEUS members to communicate to their colleagues in the science community the importance of community attention to and involvement in the activities of the NAAAC. For example, the NAAAC appears to have little knowledge of how NSF program decisions are affecting the balloon program. Dr. Kolb adjourned the SEUS meeting at 4:15 p.m.

AGENDA

Structure and Evolution of the Universe Subcommittee (SEUS)

July 1–2, 2003
NASA Headquarters
Washington, D.C.

Tuesday, July 1

Joint Session Room MIC-3

| | | |
|-------|---------------------|-----------------------------------|
| 8:30 | R. Kolb, D. Spergel | Welcome, introductions, logistics |
| 8:45 | A. Kinney | A&P Update |
| 9:30 | J. Bregman | Report from SAWG |
| 9:50 | D. Richstone | Report from APWG |
| 10:10 | | Break |
| 11:00 | R. Gehrz | Report from NAAAC (via telecom) |
| 11:30 | All | Discussion |
| 12:00 | | Working lunch |
| 12:10 | D. Schiminovich | Lunch talk: GALEX First Results |
| 1:00 | | Resume separate sessions |

SEUS Room 9H40 (PRC)

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|------|---------------|--|
| 1:00 | P. Hertz | SEU Update including Beyond Einstein, TRIP |
| 2:00 | P. Hertz | Beyond Einstein E/PO Plans |
| 2:15 | | Break |
| 2:30 | P. Looney | Interagency Coordination |
| 3:30 | R. Kolb, SEUS | GPRA FY03 Metrics |
| 4:00 | All | Discussion |
| 5:30 | | Adjourn for day |

TBD SEUS/OS Joint Dinner

Wednesday, July 2

Joint Session Room MIC-3

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|-------|----------|--------------------------|
| 8:00 | P. Hertz | Future Explorer Program |
| 8:30 | All | Discussion |
| 9:00 | C. Moore | Code R Technology NRA's |
| 9:30 | | Break |
| 10:00 | | Resume separate sessions |

SEUS Room 9H40 (PRC)

| | | |
|-------|-------------------------|------------------------------------|
| 10:00 | M. Salamon, C. Savinell | GPB Programmatic Update |
| 10:30 | P. Hertz | SPIDR Programmatic Update |
| 10:45 | J. Ormes | GLAST Mission Update |
| 11:15 | All | Discussion |
| 12:00 | | Lunch |
| 1:00 | R. Kolb, All | Discussion/prepare recommendations |
| 3:00 | R. Kolb, A. Kinney | Recommendations to Director |
| 4:00 | | Adjourn |

STRUCTURE AND EVOLUTION OF THE UNIVERSE SUBCOMMITTEE (SEUS)
MEMBERSHIP LIST

Dr. Edward W. Kolb (Chair)
Fermi National Accelerator Laboratory

Dr. Joel Bregman
University of Michigan

Dr. Michael Cherry
Louisiana State University

Dr. Lynn R. Cominsky
Sonoma State University

Dr. Charles D. Dermer
Naval Research Laboratory

Dr. Lee Samuel Finn
Pennsylvania State University

Dr. Kathryn Flanagan
Massachusetts Institute of Technology

Dr. Timothy M. Heckman
The Johns Hopkins University

Dr. Craig J. Hogan
University of Washington

Dr. Lee G. Mundy
University of Maryland

Dr. James S. Ulvestad
National Radio Astronomy Observatory

Dr. Nicholas E. White
NASA's Goddard Space Flight Center

Dr. Edward L. Wright
University of California at Los Angeles

Dr. Harold W. Yorke
NASA's Jet Propulsion Laboratory

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STRUCTURE AND EVOLUTION OF THE UNIVERSE SUBCOMMITTEE (SEUS)

July 1–2, 2003

NASA Headquarters

Washington, D.C.

MEETING ATTENDEES

Subcommittee Members:

Kolb, Edward “Rocky” (*Chair*)
Bregman, Joel
Cherry, Michael
Dermer, Charles
Finn, Lee Samuel
Flanagan, Kathryn
Heckman, Timothy
Hertz, Paul (*Executive Secretary*)
Hogan, Craig
Mundy, Lee
Ulvestad, James
White, Nicholas
Wright, Edward
Yorke, Harold

Fermi National Accelerator Laboratory
University of Michigan
Louisiana State University
Naval Research Laboratory
Pennsylvania State University
Massachusetts Institute of Technology
The Johns Hopkins University
NASA Headquarters
University of Washington
University of Maryland
National Radio Astronomy Observatory
NASA/GSFC
University of California, Los Angeles
NASA/JPL

NASA Attendees:

| | |
|---------------------|--|
| Allen, Marc | NASA Headquarters |
| Bergstralh, Jay | NASA Headquarters |
| Breckinridge, James | NASA/JPL |
| Brody, Steve | NASA Headquarters |
| Crane, Philippe | NASA Headquarters |
| Devirian, Mike | NASA/JPL |
| Geithner, Paul | NASA Headquarters |
| Hasan, Hashima | NASA Headquarters (OS Executive Secretary) |
| Hayes, Jeffrey | NASA Headquarters |
| Horowitz, Steven | NASA Headquarters |
| Howard, Rick | NASA Headquarters |
| Johnson, Lindley | NASA Headquarters |
| Jones, W. Vernon | NASA Headquarters |
| Kinney, Anne | NASA Headquarters |
| LaPiana, Lia | NASA Headquarters |
| Leisawitz, David | NASA/GSFC |
| Likins, Blake | NASA Headquarters |
| Martin, Gary | NASA Headquarters |
| Mather, John | NASA/GSFC |
| Montemerlo, Melvin | NASA Headquarters |
| Neidner, Malcolm | NASA/GSFC |
| Moore, Chris | NASA Headquarters |
| Moore, Michael | NASA Headquarters |
| Norris, Marian | NASA Headquarters |
| Ormes, Jonathan | NASA/GSFC |
| Oegerle, William | NASA/GSFC (OS member) |
| Rosenbud, Jeffrey | NASA Headquarters |
| Rummel, John D. | NASA Headquarters |

NASA Attendees (continued):

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|-------------------|-------------------|
| Salamon, Michael | NASA Headquarters |
| Shao, Mike | NASA/JPL |
| Schwartz, P.C. | NASA/GSFC |
| Smale, Alan | NASA Headquarters |
| Thronson, Harley | NASA Headquarters |
| Tsvetanov, Zlatan | NASA Headquarters |
| Varsi, Giulio | NASA Headquarters |
| Vernacchio, Al | NASA/GSFC |
| Warren, John | NASA Headquarters |

Other Attendees:

| | |
|---------------------|---|
| Bauer, David | Northrop Grumman Space Technology |
| Barentine, J.B. | Brashear LP |
| Beckwith, Steven | AURA/STScI |
| Beres, Kathleen | Orbital |
| Conte, Dominick | Spectrum Astro |
| Dehmer, Joseph | National Science Foundation |
| Di Biasi, Lamont | L. Di Biasi Associates |
| Gilman, Fred | Carnegie Mellon University |
| Green, James | University of Colorado |
| Herman, Dan | Brashear LP |
| Hillenbrand, Lynne | California Institute of Technology (OS member) |
| Holland, Mike | Office of Science and Technology Policy |
| Hundman, Eric | Office of Science and Technology Policy |
| Kaminski, Amy | Office of Management and Budget |
| Larkin, James | Univ. of California, Los Angeles (OS member) |
| Lester, Dan | University of Texas |
| Lillie, Charles | Northrop Grumman |
| Looney, Patrick | Office of Science and Technology Policy |
| Malay, Jon | Lockheed Martin |
| McNutt, Ralph | The Johns Hopkins University, Applied Physics Laboratory |
| Morgan, Bruce | AURA/STScI |
| Morse, Jon | University of Colorado, Arizona State University |
| Norman, Colin | The Johns Hopkins University (OS member) |
| Richstore, Douglas | University of Michigan (OS member) |
| Saha, Abhijit | National Optical Astronomy Observatories (OS member) |
| Schiminovich, David | California Institute of Technology |
| Solomon, Sean | Carnegie Institution of Washington |
| Spergel, David | Princeton University (OS Chair) |
| Staffin, Robin | Department of Energy |
| Traub, Wesley | Harvard-Smithsonian Center for Astrophysics (OS member) |
| Van Citters, Wayne | National Science Foundation |
| Weinberger, Alycia | Carnegie Institution of Washington (OS member) |

STRUCTURE AND EVOLUTION OF THE UNIVERSE SUBCOMMITTEE (SEUS)

July 1–2, 2003

NASA Headquarters

Washington, D.C.

LIST OF PRESENTATION MATERIAL⁴

- 1) Dr. Anne L. Kinney, Director, Astronomy and Physics Division, Office of Space Science, NASA. *Astronomy and Physics Division Overview.*
- 2) J. N. Bregman, Chair, W. Oegerle, Deputy Chair, Science Archive Working Group. *Report of the SAWG: July 1, 2003.*
- 3) *Report of the April 2003 Meeting of the Science Archive Working Group.*
- 4) *APWG Draft Letter, Meeting June 16–17, 2003.*
- 5) Bob Gehrz, Chair, National Astronomy and Astrophysics Advisory Committee. *NSF–NASA National Astronomy and Astrophysics Advisory Committee (NAAAC) Recommendations on the LSST.*
- 6) Paul Hertz, SEU Theme Scientist, NASA. *SEU Theme Update: Presentation to SEUS.*
- 7) Paul De Minco, SEU Theme Integration Manager, NASA. *SEU and Beyond Einstein Education and Public Outreach Strategic Plan Initiative.*
- 8) Patrick Looney, Assistant Director, Physical Science and Engineering, Office of Science Technology and Policy. *What's Happening at OSTP?.*
- 9) Alan Smale, A&P, NASA. *OSS/SEU GPRA Metrics for FY03.*
- 10) Paul Hertz, Explorer Program Scientist, NASA. *Explorer Options for the Future: Presentation to the SEUS and OS, July 2, 2003.*
- 11) Chris Moore, Office of Aerospace Technology, NASA. *Fundamental Technology Development for Space Science.*
- 12) GP-B Risk Review Team, A&P, NASA. *Report of the GP-B Risk Review Team.* Submitted on 24 April 2003 to Dr. Anne Kinney, Director, Astronomy and Physics Division.
- 13) Paul Hertz, SEU Theme Scientist, NASA. *SPIDR Update: Presentation to SEUS.*
- 14) Jonathan F. Ormes, Project Scientist, GLAST Mission, Goddard Space Flight Center. *GLAST Mission Update.*
- 15) Michael Salamon, Program Scientist, and Chris Savinell, Program Executive, Astronomy and Physics Division, NASA. *Gravity Probe–B: Reviews and Current Status.*
- 16) GP-B Science Review Team, A&P, NASA. *Report of the GP-B Science Review Team.* Submitted on 21 April 2003 to Dr. Anne Kinney, Director, Astronomy and Physics Division.

⁴ Presentation and other materials distributed at the meeting are on file at NASA Headquarters, Code S, Washington, DC 20546. Some materials are available online at

<<http://space.science.nasa.gov/admin/divisions/sz/SEUS0307/>>